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April 25, 2001

Ms. Magalie R. Salas, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

**Re: ET Docket No. 00-47, Authorization and Use of
Software Defined Radios**

Ex Parte Filing

Dear Ms. Salas:

Pursuant to Section 1.1206(a)(2) of the Commission's Rules, I am filing the original and one copy of this letter to report an oral ex parte communication in the above-referenced proceeding.

Yesterday John Chapin of Vanu, Inc. and the undersigned met with Lisa Gaisford, Julius P. Knapp, Karen Rackley, Alan R. Stillwell, and Hugh L. van Tuyl of the Commission staff.

Mr. Chapin and I reiterated and expanded on the substance of Vanu, Inc's filings in this proceeding. A copy of our presentation outline is attached.

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If there are any questions about this filing, please call me at the number above.

Respectfully submitted,

Mitchell Lazarus
Counsel for Vanu, Inc.

cc: Meeting participants
Bruce A. Franca, FCC
Michael J. Marcus, FCC

FCC Should Permit Separate Certification of Signal Processing Software for SDR

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Software Defined Radio: docket FCC 00-47

- **SDR definition**
 - operating parameters of transmitter can be changed through software
- **Goals**
 - more efficient use of spectrum
 - enhanced interoperability
- **Status**
 - NOI March 21, 2000 FCC 00-103
 - Nprm December 8, 2000 FCC 00-430
- **Vanu, Inc. Comments**
 - filed **March 19, 2001**



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Joint vs. separate certification

- Joint
 - FCC certifies platform and software **as integrated unit**
 - high cost: M services, N platforms, M^*N certifications
- Separate
 - FCC certifies software **separately from platform**
 - software tested on a **representative platform**, not on all
 - only M+N certifications
- Concerns about separate certification
 - software behavior **not predictable when ported**
 - **harmful or interfering transmissions may result**



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FCC has supported joint certification

- NPRM 00-430, Dec 8, 2000, p. 7:

“We agree that radio hardware and software should be approved together... This is the only way at the present time to ensure that equipment complies with the technical standards in our rules to prevent interference and to protect users from excessive RF radiation.”



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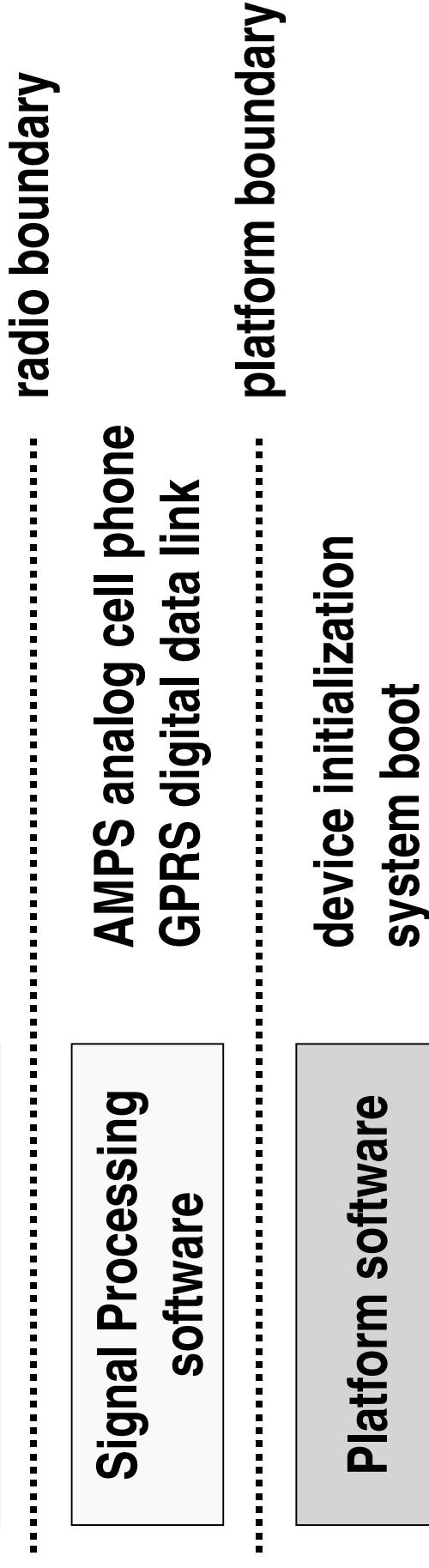
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Device software is not monolithic

Example functionality

Application software

**user interface, datebook
internet routing**



Platform software

**device initialization
system boot**

Hardware

**processor
TX/RX chains**



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Definitions of terms

- “**SP software**”
 - signal processing software
 - the higher level of the radio
 - encodes a particular communications standard (AMPS, IS-95, etc.)
 - may include state machines, encryption software, etc.
- “**platform**”
 - a combination of hardware and software
 - the lower level of the radio
 - provides services used by SP software
 - protects against non-compliant transmissions



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Proposal: separate certification of SP software

Certification rules

Application software

Not regulated

**Signal Processing
software**

***SP software can be separately certifiable
without risk of noncompliance.***

Platform software

**Class III permissive
change**

**Requires
joint
certification**

**Class I
Class II
Relabel**

Hardware



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SP software *should* be separately certifiable

- SDR goals require agile devices
- Efficient use of spectrum requires a diversity of SP software
- Allowing separate certification furthers policy goals
 - reduce certification cost and time: $M^*N \rightarrow M+N$
 - amortize SP development cost over many platforms
 - encourage innovation in radio technologies
 - encourage independent software vendors in niche markets such as public safety



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SP software can be separately certified

- **Concerns**
 - software behavior not predictable when ported
 - harmful or interfering transmissions may result
- **Solution**
 - **securely tag SP software with permitted TX parameters**
 - neither tag nor software can be modified undetectably
 - platform can verify that tag was created by authorized party
 - **design platform software and hardware to limit transmissions to those permitted by the tag**



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Mechanisms exist that can limit transmissions

- See Vanu, Inc white paper in docket FCC 00-47
 - SDR Platform Mechanisms for Enforcing Transmission Limits on Signal Processing Software
 - filed April 25, 2001
- Key technical ideas
 - attach cryptographic tag to SP software downloads
 - use a processor and OS that supports virtual memory
 - use device drivers to check TX chain configuration
 - add filters to TX chain for use by platform software



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All critical TX parameters can be limited

- The platform can efficiently and economically limit
 - permissible frequency band
 - center frequency of transmission
 - bandwidth of transmission
 - in-band power
 - peak-to-average power ratio
 - out-of-band power (research needed to reduce cost)
 - smart antenna configuration
- The platform cannot efficiently/economically limit:
 - aspects of modulation type other than Peak/avg ratio
 - higher levels of the standard: timing, packet formats, etc.



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Initial bands for separate SP certification

- Initial SP certification appropriate for
 - auctioned bands
 - other unshared geographic bands (e.g., cellular)
 - unlicensed bands
- Further experience needed for
 - services in which multiple licensed users share the band



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Proposed regulatory approach

- Manufacturer's option: Type J or Type K
- SDR Type J
 - Certification as proposed in Nprm
 - only software certified with a given SDR platform may be used
- SDR Type K
 - Type K platform certification
 - Type K SP software certification
 - Type K certified SP software may be used on any Type K certified SDR platform



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Regulatory challenges for SDR Type K

- Definitions
 - application software
 - signal processing software
 - platform software
- Testing
 - how to ensure platforms are tested with a sufficiently wide range of SP software behavior?



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Definition challenges

- **Definition based on functionality is problematic.**
 - Functions of layers not easily defined
 - Difficult to anticipate future functionality due to technology changes
- **Working on a different approach**
 - definitions based on potential effects on compliance



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Safety vs Liveness

- Two kinds of correctness properties
 - Safety
 - X does not do something Y that is forbidden
 - e.g., a word-processor does not affect operation of a spreadsheet
 - If X fails, it may do Y
 - Liveness
 - X does something Y it is supposed to do
 - e.g., pressing “save” actually saves the file
 - If X fails, it may fail to do Y



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Working definitions

- Application software
 - Correctness is not required for the radio to remain in compliance.
- Signal processing software
 - Safety is required but liveness is not required for the radio to remain in compliance.
- Platform software
 - Correctness is required for the radio to remain in compliance.



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Intent of "application software"

- **Include all software unrelated to radio functions**
 - user interface, calendar, phonelist
- **Include software that selects an allowable radio mode**
 - this is the same as turning a dial on the front panel of today's multi-mode or multi-band radio
- **Not applicable to platforms without protection**
 - if a defect in an application could lead to noncompliance, the application must be included in the certification testing



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Intent of "signal processing software"

- **Include a full implementation of an air standard**
 - an AMPS or IS-95 cell phone
 - an APCO 25 land mobile radio
 - etc.
- **Allow application components in SP software**
 - Metricom-type routing software



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Intent of "platform software"

- **Include any software that:**
 - directly controls the TX chain
 - defends against faulty higher layers
 - is part of the trusted computing base that implements the device's security mechanisms
- **Examples**
 - operating system, firmware, boot ROMs
 - software that authenticates downloads or upgrades
 - software that enforces transmission limits



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SDR Type K SP software certification

- Requirements:

- The SP software has been tested on a representative platform and shown to comply with the technical rules for the relevant services.
- The SP software has been tagged with limits on ... in accordance with the technical rules for the relevant services.
- **Type K certified SP software may be used on any Type K certified platform.**



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SDR Type K platform certification

- **Requirements:**

- The platform refuses execution of Type K SP software if either the software or the tag has been modified by an unauthorized party.
- The platform refuses execution of Type K SP software if the platform is not capable of enforcing the limits specified in the tag.
- The platform prevents transmissions by Type K SP software that violate the limits specified in its tag, even if the software is faulty.
- The platform prevents modification of the platform software or data by Type K SP software, even if that software is faulty.



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Conclusions

- Main points
 - Separate certification is a key enabler for SDR goals.
 - Separate certification is safe for signal processing software, if:
 - the software is tagged with transmission limits
 - the platform is designed properly
- The Commission should modify its proposed rules to allow a new category of SDR devices which permits separate certification of signal processing software.



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